

Having thus described the preferred embodiments, the invention is now claimed to be:

1. An apparatus for measuring toner concentration in a developer contained in a developer housing, the apparatus comprising:

5 a developer sample container that receives a portion of developer extracted from the developer housing;

a spectrophotometer that measures spectrophotometric data for the portion of the developer in the developer sample container; and

10 a processor that estimates the toner concentration based on the measured spectrophotometric data and a pre-determined relationship between the spectrophotometric data and the toner concentration.

2. The apparatus as set forth in claim 1, further comprising:

a surfactant or solvent that is mixed with the portion of developer extracted from the developer housing.

15 3. The apparatus as set forth in claim 1, wherein the pre-determined relationship further comprises:

a pre-determined empirical relationship between toner concentration and spectrophotometric data.

20 4. The apparatus as set forth in claim 3, wherein the pre-determined empirical relationship comprises:

an empirical relationship between the percent toner concentration and at least one of an L*, a*, b*, chroma, hue, and a CMC color difference color parameter.

5. The apparatus as set forth in claim 3, wherein the pre-determined empirical relationship includes:

25 an empirical correction for the usage of the developer.

6. The apparatus as set forth in claim 5, further wherein the empirical correction for the usage of the developer comprises:

an empirical correction that incorporates the number of prints printed using the developer prior to testing with the apparatus into the empirical relationship between toner concentration and spectrophotometric data.

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7. The apparatus as set forth in claim 1, further comprising:

a leveling device for leveling the surface of the developer sample.

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8. A method for measuring toner concentration in a developer comprising:
extracting a sample of the developer;
measuring color characteristics of the developer sample; and
estimating the toner concentration based on the measured color characteristics.

9. The method as set forth in claim 8, further comprising:
mixing the developer sample with a solvent or surfactant prior to measuring color characteristics.

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10. The method as set forth in claim 8, wherein the estimating of the toner concentration based on the measured color characteristics further comprises:
comparing the measured color characteristics with a pre-determined empirical relationship between a color characteristic and the toner concentration; and
estimating the toner concentration based on the comparing.

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11. The method as set forth in claim 10, wherein the comparing of the measured color characteristics with a pre-determined empirical relationship includes:
comparing at least one of a measured CMC color difference, L*, a*, b*, chroma, and hue color parameter with a pre-determined empirical relationship between the measured parameter and the toner concentration.

12. The method as set forth in claim 8, wherein the estimating of the toner concentration based on the measured color characteristics includes:
accounting for the usage of the developer in the estimating.

13. The method as set forth in claim 8, further wherein the estimating of the toner concentration based on the measured color characteristics includes:
comparing the measured color characteristics with a pre-determined empirical relationship between a color characteristic and the toner concentration wherein said comparing includes correcting for the usage of the developer; and
estimating the toner concentration based on the comparison.

10 14. The method as set forth in claim 8, further comprising:
leveling the developer sample.

15 15. A method for estimating the toner concentration in a developer comprising a toner and a carrier, the method comprising:
measuring a color characteristic of the developer;
comparing the measured color characteristic with a pre-determined relationship between the color characteristic and the toner concentration; and
estimating the toner concentration based on the comparing.

16. The method as set forth in claim 15, further comprising:
in the comparing step, accounting for a change in the color characteristic of the developer due to usage.

20 17. The method as set forth in claim 16, wherein the accounting for a change in the color characteristic of the developer due to usage includes:
receiving the number of prints which have been printed using the developer; and
accounting for the change in the color characteristic using a pre-determined
25 relationship between the color characteristic and the number of prints which have been printed using the developer.

18. The method as set forth in claim 15, wherein the measuring of a color characteristic of the developer comprises:

placing a sample of the developer into a sample container; and
measuring the color characteristic of the sample in the sample container.

5 19. The method as set forth in claim 18, wherein the measuring of a color characteristic of the developer comprises:

leveling the sample of the developer in the sample container.